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THE EFFECT OF VANADIUM ON THE PHAGOCYTE ACTIVITY OF LEUCOCYTES OF THE GUINEA PIG

[Uliyaniye vanadiya na fagotsitarnuyu aktivnost' leykotsitov morskikh svinok]

T. Kh. Kuliyeva

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THE EFFECT OF VANADIUM ON THE PHAGOCYTE ACTIVITY OF LEUCOCYTES OF THE GUINEA PIG

T. Kh. Kuliyeva

As is known, the phagocyte capacity of the leucocytes [1] is among the important protective reactions of the organism. The study of the factors that influence this reaction is one of the pressing medical problems. There are indications that a number of trace elements (copper, zinc, iodine, mercury) are capable of stimulating the phagocyte activity of leucocytes [4, 5, 6, 7, 8].

The role of vanadium in the indicated processes has not been studied. However, as our previous data showed, as a trace element, vanadium is capable of stimulating the processes of tissue respiration. It is natural to anticipate that a change in the intensity of the metabolic processes should also be reflected in the function of the leucocytes. This circumstance stimulated us to undertake an investigation of the effect of vanadium on their phagocyte activity.

During the investigation of the physiological role of trace elements, a principally important question is finding the dose level at which the given trace element appears as a biotic factor. With this goal, our experiments were carried out with different amounts of vanadium (different from those in which it is approximately encountered in the environment, and before the clearly toxic ones).

The experiments were performed on guinea pigs (a total of 63 specimens), weighing from 400 to 500 grams. The animals, divided into three groups, perorally received aqueous solutions of sodium metavanadate for 10 - 15 days in concentrations of 0.025 mg%, 1 mg%, and 40 mg%. These were given in recalculation for the metal in daily vanadium doses (3.2 µg/kg, 128 µg/kg, 5.12 mg/kg live weight).

The phagocyte activity of the leucocytes was determined before giving vanadium (control measurements averaged 15), and 10 - 15 days after giving vanadium. Measurement was carried out according to the VIEM method, modified by Kost and Stenko.

A half volume of 2% sodium citrate was taken in capillaries from the Panchenkov apparatus. Then, one volume of blood and a half volume of staphyloccus aureus culture in a 2 billionth dilution were added. After the liquid has been stirred, it was placed in a thermostat at 37° for 30 minutes. Then, drops of suspension for preparing 3 - 4 smears were taken from the newly stirred liquid. The dried smears were stained after Romanovskiy-Gemsa.

One hundred leucocytes were counted in each smear. Of these, the number of leucocytes with phagocytized microbes was noted (the phagocyte number was determined). Then, the number of phagocytized microbes was counted in each of them (the phagocyte index was derived).

It was established that a change in the phagocyte activity of guinea pig leucocytes occurred under the effect of sodium metavanadate taken daily for 10 - 15 days. Phagocyte activity depended upon the employed dosage of vanadium.

In the group (21 specimens) that received vanadium daily in a dose of 3.2 µg/kg (0.025 mg% solution), a statistically reliable increase in the phagocyte activity of leucocytes was noted ($P < 0.02$). With an increase in dosage to 128 µg/kg (1 mg% solution), a statistically reliable change was absent ($P < 0.5$).

In the group (21 specimens) in which vanadium was given for 10 days in a dose of 5.12 mg/kg (40 mg%), phagocytosis decreased ($P < 0.001$).

Hence, the experiments that were conducted demonstrated the selective relationship of the guinea pig organism to extremely small amounts of vanadium (daily dose — 3.2 μg/kg). After its fifteenth application, the strength of phagocytosis increased 14.3% in comparison with the initial values. These amounts of vanadium should be viewed as the biotic amounts, i.e., those in which the given trace element is a factor that influences the internal systems of the organism by participating in the biochemical processes (the zone of biotic effect).

A sharply increased (1600 times) vanadium dosage (5.12 mg/kg) under the same experimental conditions suppressed the strength of phagocytosis by 47.8% (zone of toxic effect). The intermediate dose of vanadium between the two above-referenced ones (128 μg/kg) had no statistically reliable effect — the changes were within the boundaries of variability of the phenomenon (zone of ineffectiveness).

The described form of the reaction of the guinea pig organism to various amounts of vanadium was also observed earlier by the author in the investigation of its effect on the intensity of oxygen consumption. The data obtained by the author are within the framework of the concept of "zonality of effect of trace elements [2, 3].

Conclusions

Following daily (for 10 - 15 days) peroral entry of aqueous solutions of sodium metavanadate into the organism of guinea pigs, the following were noted: a daily dose of 3.2 μg/kg increases the phagocytic activity of leucocytes ($P < 0.02$); a dosage of 128 μg/kg produces no statistically reliable effect ($P < 0.5$); a dose of 5.12 mg/kg suppresses the strength of phagocytosis ($P < 0.001$).

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